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DISTRIBUTION AND NOTES ON THE GREAT DISMAL SWAMP POPULATION OF *MITOURA HESSELI* RAWSON AND ZIEGLER (LYCAENIDAE)

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ABSTRACT. The microdistribution of *M. hesseli* within selected areas of the Dismal Swamp (VA and NC) is found to be coincident with the occurrence of its larval foodplant, *Chamaecyparis thyoides* (L.) B.S.P. (Cupressaceae). Observations on nectar feeding, apparent predation on adults by birds, perching behavior by adult males, and other behavioral phenomena are reported. Two new categories of beak-inflicted wing damage in Lepidoptera are described, and a possible selective advantage for the dorsal "false head" found in many lycaenid species is discussed. The white spot of the discal cell of the ventral forewing is found to be an unreliable character for separating *M. hesseli* from *M. gryneus* (Hübner) in Virginia, but the subterminal brown bars in cells M_1 and M_2 of the ventral hindwing are unique to *M. hesseli*.

Since its original description and the subsequent description of its early stages (Rawson et al., 1951), little has been published concerning the biology or behavior of Hessel's hairstreak, *Mitoura hesseli* Rawson and Ziegler (1950). Progressive range extensions have been reported (Pease, 1963; Anderson, 1974; Johnson, 1978; Baggett, 1982); and it appears that this insect will be found throughout the range of its larval foodplant, *Chamaecyparis thyoides* (L.) B.S.P. (Cupressaceae).

The geographic proximity and the morphological and biological similarities between *M. hesseli* and *M. gryneus* (Hübner) suggest recent speciation. Although the normal foodplant for *M. gryneus* is *Juniperus virginiana* L. (Cupressaceae), it has been successfully reared on *C. thyoides* (Remington & Pease, 1955); and Gifford and Opler (1983) have reared *M. hesseli* on *J. virginiana*. The wing patterns of the two species are nearly identical, and the genitalic similarities (and differences) were reported by Johnson (1976).

In view of this close biological relationship, the reported behavioral differences between the two species appear striking. The literature suggests that, except for at the type locality, *M. hesseli* is an infrequent find even in the vicinity of *C. thyoides* and is best collected at flowers near the foodplant rather than on the foodplant itself. The pugnacious territoriality of adult male *M. gryneus* is well known (Johnson & Borgo, 1976), and experience with this species in Virginia shows that it is rather ubiquitous. A short hedgerow of several *J. virginiana* is adequate to support a double-brooded colony. It is intriguing that the microdistribution and adult behavior of *M. hesseli* should vary so greatly from its closest extant relative. The authors were able to study the *M. hesseli* population in the Great Dismal Swamp National Wildlife Refuge, located in southeastern Virginia and northeastern North Carolina, for the purpose of clarifying the nature of these differences and perhaps uncovering some explanation for them.

MATERIALS AND METHODS

The study site was the Great Dismal Swamp National Wildlife Refuge (the Refuge), located approximately between latitudes 36°26′N and 36°48′N and longitudes 76°22′W and 76°33′W. A thorough characterization of the Refuge and surrounding swamp was given by Kirk (1979). *Chamaecyparis thyoides* is found in the Refuge as an invader of ditch edges, as a member of variable dominance in a generally mixed hardwood forest, and in pure stands of many hectares extent (Fig. 1). Roads and ditches provide the only access to the Refuge interior, although it is possible to penetrate off-road areas on foot with great difficulty. All roads follow ditches, but many ditches are unaccompanied by roads and are often impassable due to rooted and fallen vegetation.

Several trips were made in 1981 to scout potential sites for locating *M. hesseli*. With the aid of a vegetation map provided by the Refuge administration, those areas of *C. thyoides* accessible by vehicle were identified. In 1982, a qualitative sampling program was begun. Selected 0.8 km (0.5 mi.) sections along passable roads were sampled for *M. hesseli*. Each section was sampled at least once, and there was no uniformity of sampling effort. With the one exception described below, the collection or positive sight identification of two specimens was sufficient to consider a section positive for *M. hesseli*. Flowering shrubs, vegetation perches, and damp patches in the road were examined thoroughly. Enough other spring species were in flight to ensure that sections not near *C. thyoides* would be examined as closely as those near the foodplant. This regimen was followed on 3, 13, 19, and 20 April and in the late afternoon only of 2 April. Approximately 24 km of road were examined in this manner, and sections were selected so that about one third were in areas where *C. thyoides* could be seen along the road or in the forest. The remaining sections were at various distances from the foodplant.

On 13 April, a 5- to 6-meter-wide trail through a dense stand of mature *C. thyoides* was discovered and followed for ca. 1 km (Fig. 1, point A). The edges of the trail were lined with immature *C. thyoides*,

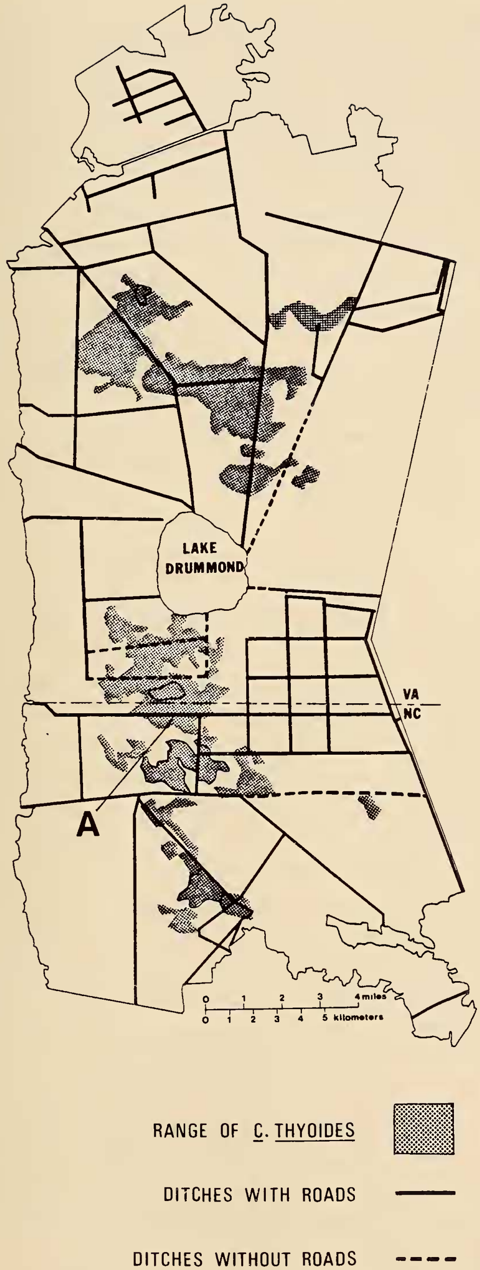

FIG. 1. Distribution of *Chamaecyparis thyoides* within the Great Dismal Swamp National Wildlife Refuge in relation to roads and ditches. Point A is site of trail discussed in text. (Adapted from U.S. Geological Survey open-file map 76-615.)

4–6 m tall, behind which loomed the crowns of mature trees, 18–22 m tall. *Mitoura hesseli* was abundant along this trail, and a series was collected for later examination. The remaining field data consisted of general observations on the behavior and habits of this butterfly species.

Out of the field, 32 adults were sexed and examined for the presence of both the white spot in the discal cell of the ventral forewing and the brown bars distad of the postmedian line in cells M_1 and M_2 of the ventral hindwing, several characters used by authors to differentiate *M. hesseli* from *M. gryneus* (Rawson & Ziegler, 1950; Clench, 1961; Howe, 1975). A series of *M. gryneus* (n = 74) was similarly examined. The latter specimens were collected in Virginia, although none was collected in the vicinity of the Refuge. Rudimentary white spots of only several scales were considered as absent.

A single visit to the Refuge was made on 6 July 1982 expressly to photograph *M. hesseli* in its natural setting. Some supporting observations were made at this time.

RESULTS AND DISCUSSION

Distribution. Positive and negative collection sites are indicated in Fig. 2. Ditches and roads have been removed from this figure for clarity. The negative results in the vicinity of a mature stand of *C. thyoides* (Fig. 2, point A) are likely artifactual. This site was visited at ca. 0900 EST on an overcast day with winds to 77 kph (48 mph) and was the only site in the vicinity of the foodplant which did not yield *M. hesseli*. Summer-brood individuals were abundant here on 6 July, and it is assumed that the aforementioned weather conditions were responsible for the negative findings in April. Neighboring areas proved to be densely colonized when examined under more favorable weather conditions. Point B in Fig. 2, in combination with the positive samples to the east of it, suggests that *M. hesseli* is likely found throughout that northwestern stand of *C. thyoides*. Other such opportunities (in which a stand could be bracketed by samples) were unfortunately unavailable. Point C in Fig. 2 is the only section which was positive for *M. hesseli* based only on sight records. No *C. thyoides* grew along the road or in the forest along this section, but it had recently invaded the far bank of the adjacent ditch. *Mitoura hesseli* was seen nectaring on blossoms of *Vaccinium corymbosum* L. (Ericaceae) along that bank, just out of reach of our nets. Sights not in the vicinity of *C. thyoides* were consistently negative.

General observations. *Vaccinium corymbosum* was the dominant flowering plant in the Refuge on 2, 3, and 13 April; and it rarely grew far from *C. thyoides*. In contrast to the findings of Rawson and Ziegler (1950) in New Jersey, *M. hesseli* was found to utilize *V. corymbosum*

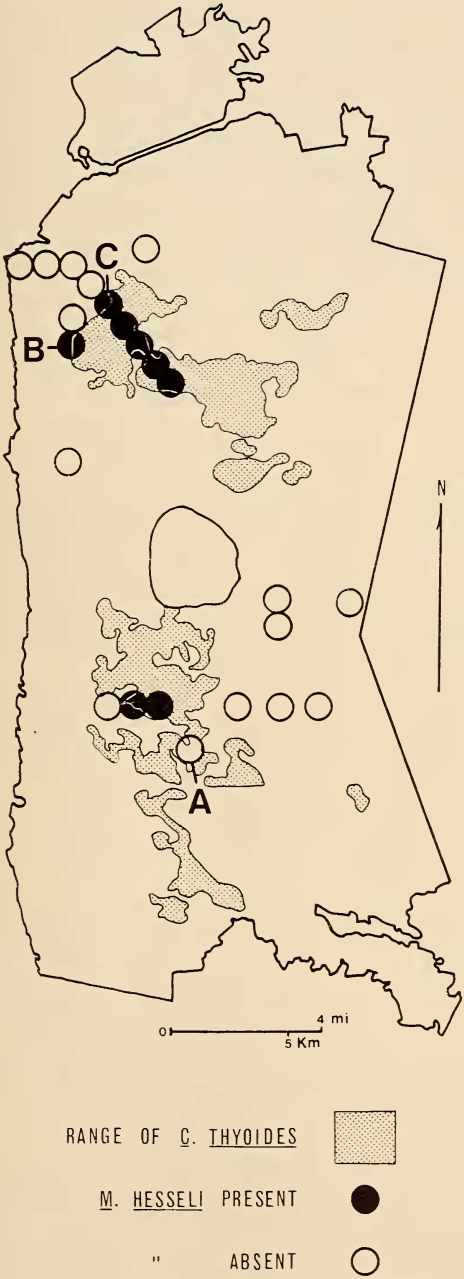

FIG. 2. Results of qualitative sampling program, illustrating the distribution of *Mitoura hesseli* in relation to its larval foodplant, *Chamaecyparis thyoides*, within the Great Dismal Swamp National Wildlife Refuge. Points A and B are discussed in text; Point C is based on sight records only.

readily as a nectar source. Most specimens thus collected were female, but the actual sex ratio was unrecorded. By 19 April, *V. corymbosum* was past flowering; and other plants with varied distributions were beginning to flower. *Amelanchier intermedia* Spach (Rosaceae) was the only additional bloom on which *M. hesseli* was seen to nectar in the spring. *Sassafras albidum* (Nutt.) Nees (Lauraceae) and an unidentified willow (*Salix* sp., Salicaceae) were flowering locally but not near any site at which *M. hesseli* was recorded. Summer-brood individuals were seen to utilize *Cephalanthus occidentalis* L. (Rubiaceae), *Phytolacca americana* L. (Phytolaccaceae), and *Apocynum* sp. undet. (Apocynaceae) as nectar sources. Despite many fresh flower heads of *Achillea millefolium* L. (Compositae) and *Daucus carota* L. (Umbelliferae) in the immediate vicinity of abundant *M. hesseli*, neither was ever visited by the butterfly during several hours of observation (late afternoon, 6 July).

The flight of *M. hesseli* when nectaring is very distinct from that of *M. gryneus*. While the latter retains its darting flight when approaching nectar sources, the former assumes a fluttering, casual flight, at least at *Vaccinium* blossoms. In one instance, while beating bushes to dislodge perching or nectaring individuals, a female *M. hesseli* was seen to remain undisturbed even though the flower cluster on which she was nectaring was roughly shaken. In July, a second female was perched out of camera range on a *C. occidentalis* blossom, and she could not be dislodged with repeated, direct taps of the net handle. The senior author broke off the branch on which she was perched and brought it into a clear area where he was able to photograph the specimen at close range for several minutes until the butterfly, apparently sated, flew away.

Two or three specimens of *M. hesseli* (sex unrecorded) were seen to flounder across the road as if in physical distress. When collected, these proved to be fresh, post-teneral specimens with no evident, external injuries. These may have been diseased or parasitized individuals, or they may have been struck by passing vehicles. The latter possibility is unlikely since there is almost no vehicular traffic within the Refuge, but it cannot be discounted. No attempt was made to culture disease agents or rear parasites from these specimens.

The walk along the trail revealed hitherto unreported behavior patterns in *M. hesseli*. Here this species behaved much the same as *M. gryneus*. Males were seen perching on immature *C. thyoides* and darting out after passing butterflies and other insects. Most were seen on the sunlit side of the trail, and most selected perching positions in the top third of the trees. Numerous "dogfights" were seen involving two or three individuals, and individuals were occasionally seen visiting

Vaccinium blossoms, at which their flight showed no sign of the lethargic pattern described earlier. No females were seen or collected along this trail except for a single specimen collected on blossoms near the far end of the trail. No activity was seen around the canopy of the surrounding stand of mature foodplant, but the distance precluded conclusive observations. Two specimens (sexes unrecorded) were seen to land upon the trail and walk about for several cm, eventually climbing down into crevices formed by fallen limbs in the mud. Here they would quietly sit with only the tips of their hindwings exposed. These individuals are presumed to have been tippling ground moisture, although the forward portion of their bodies could not be seen to confirm this. It is also not known why they crawled into crevices to get moisture, since most of the trail surface was mud. No matings were observed for this species.

Predation. Evidence of predation by birds was seen in specimens collected during this study. Although no attacks were observed, numerous insectivorous birds are found in the area (Anonymous, 1980). Since Sargent's (1976) classification of beak damage was designed for and applied to noctuid species, no category (Type I, Type II, or Type III) is descriptive of the damage inflicted on Lepidoptera which rest with wings folded upright over the back. The resulting damage from an attack on an insect in this position is manifested in either two or four wings and is always bilaterally symmetrical. In keeping with Sargent's (1976) nomenclature, the names Type IV and Type V damage are suggested. Type IV damage (Fig. 3) is caused by attacks in which the beak is oriented roughly parallel to the major veins in the insect's wings. The beak crosses the wing margin rather than the costa. Three subcategories are recognized: IVa, which involves only the forewings; IVb, which involves only the hindwings and is typical of thecline lycaenids (Robbins, 1980); and IVc, which involves both fore- and hindwings. Type V damage (Fig. 4) is caused by bites which cross the forewing costa. Here two subcategories are possible: Va, which does not extend to the hindwing costa; and Vb, which does.

Type IV damage generally results in notches in the wings, but Type V damage rarely does. In the latter case, beak imprints instead of notches are left on the forewing (in the case of Type Va attack), and no example of Type Vb damage has been seen. It is likely that Type Vb attacks are almost always successful due to the unlikelihood of the forewing costa tearing to allow the insect to escape (Robbins, 1980). This leaves to be explained why individuals with Type Va damage are observed, since the predator grasps the prey by the costae in this type of attack, also. The authors suggest that the insect's reaction to a Type Va attack is to snap open the hindwings (as a natural attempt at flight),

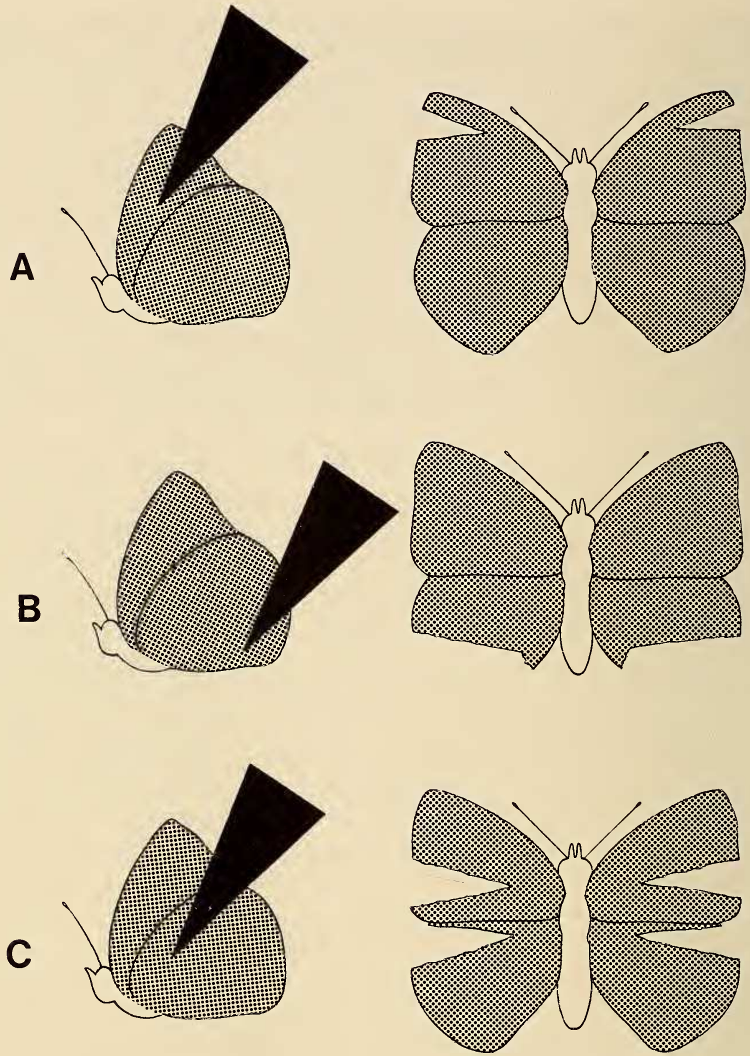

FIG. 3. Diagrammatic illustration of Type IV bird attack and resulting wing damage. **A)** Type IVa involves forewings only; **B)** Type IVb involving hindwings only (illustrated with remaining anal fragments removed, as is the case in many field-collected specimens); **C)** Type IVc involving all wings (after Sargent, 1976).

startling the bird and thus facilitating an escape. This may help to explain why so many thecline species exhibit a rudimentary "false head" on the dorsum of the hindwings as well as the more well developed one on the ventrum. Besides providing a deflection target for

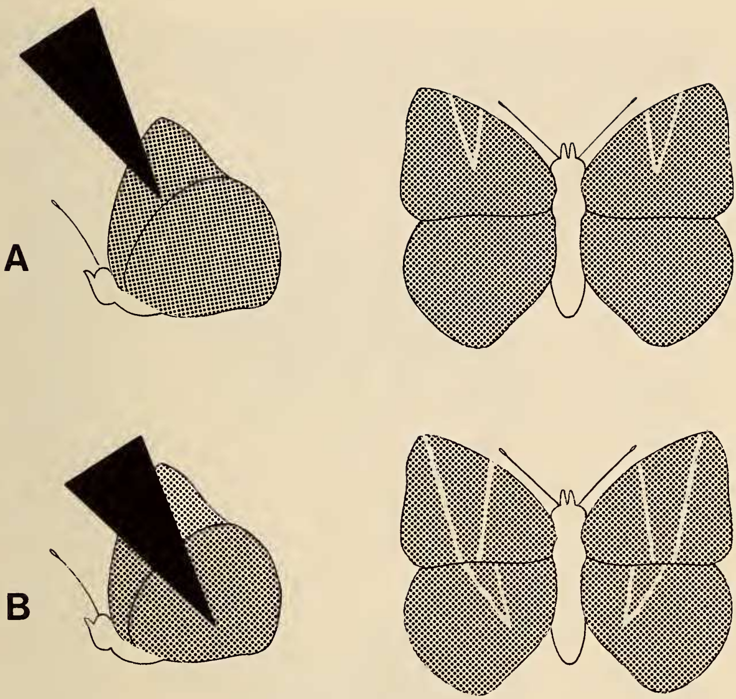

FIG. 4. Diagrammatic illustration of Type V bird attack and resulting wing damage. **A)** Type Va involving only the forewings; **B)** Type Vb involving all wings (after Sargent, 1976).

Type I attacks (attacks while in flight), an eyespot in this position would contribute to the startle effect in the event of a Type Va attack.

Fig. 5 illustrates damage types IVb, IVc, and Va, as found in the Refuge population of *M. hesseli*.

Wing maculation. The 15 male *M. hesseli* examined showed no white spot in the discal cell of the ventral forewing. Fifteen of 17 females (88.2%) had the white spot; the remaining two did not. Overall, 46.9% (n = 32) had the white spot. Of 74 *M. gryneus* examined, 6 of 58 males (10.3%) and 0 of 16 females had the spot. Overall, 8.1% had the spot.

This character does not appear to be reliable enough for field identification and should probably be omitted from future keys separating these two species. This trait appears sex dependent, reversed from one species to the other, but the significance of that (or even its validity) is uncertain based on these limited data.

All *M. hesseli* and no *M. gryneus* examined showed the brown bars

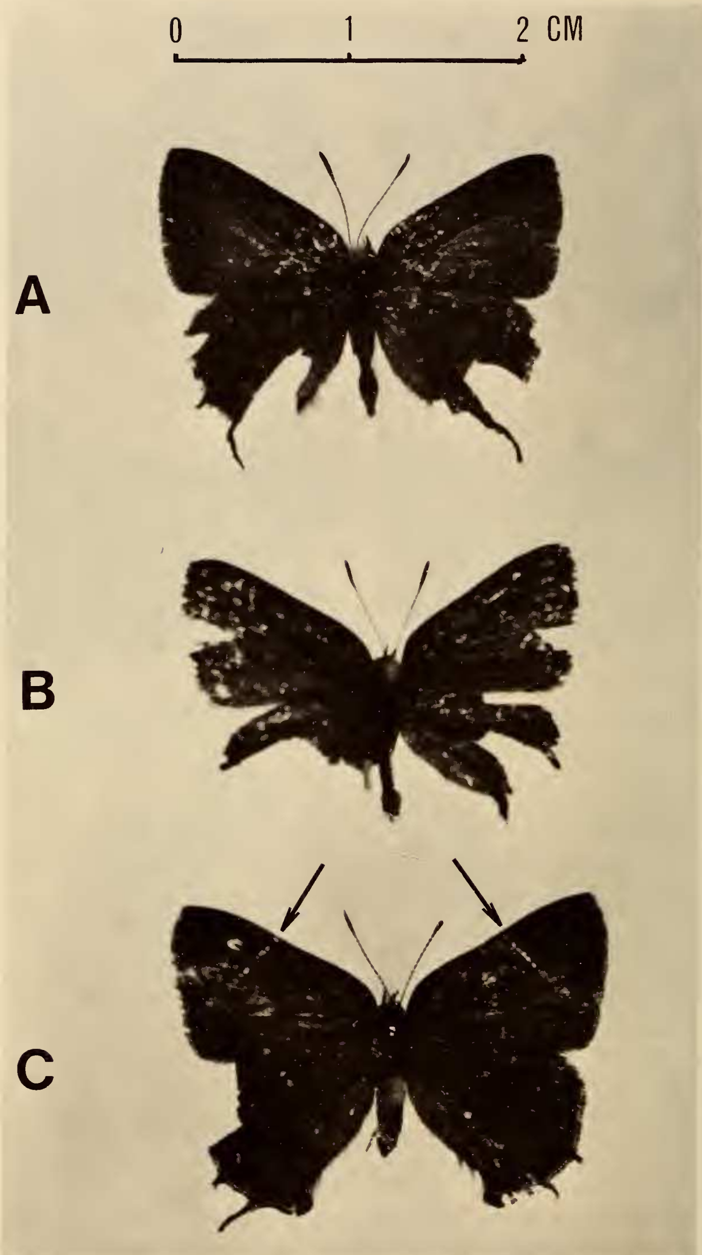

FIG. 5. *Mitoura hesseli* showing Types IV and V wing damage. **A)** Type IVb damage (♂, Great Dismal Swamp, Camden Co., NC, 13-iv-1982); **B)** Type IVc damage (♂, same data as A) with anal area of left hindwing missing, also; **C)** Type Va damage with beak imprints indicated by arrows (♀, Great Dismal Swamp, Suffolk, VA, 13-iv-1982).

distal to the postmedian line in cells M_1 and M_2 of the ventral hindwings. The number examined was slightly less for both species because of individuals with Type IVb damage which obliterated this character. We suggest that this character be used for field separation of these two species.

SUMMARY

The Great Dismal Swamp harbors a large population of *Mitoura hesseli* Rawson and Ziegler. With one exception which may be explained by poor weather conditions at the time of the spring visit, all sample areas containing *Chamaecyparis thyoides* (L.) B.S.P., produced Hessel's hairstreak. Summer-brood individuals were abundant at this one negative site. Areas narrowly removed from the foodplant were consistently nonproductive. *Vaccinium corymbosum* L., *Cephalanthus occidentalis* L., *Phytolacca americana* L., *Apocynum* sp., and *Amelanchier intermedia* Spach were observed as nectar sources for *M. hesseli*, and females were more common at flowers than were males. An area of immature *C. thyoides* at the margin of a mature, pure stand of that species revealed *M. hesseli* males perching and darting in a manner indistinguishable from *M. gryneus* (Hübner). No matings were observed, and it is suggested that the mature foodplant canopy be examined for its role in the ecology of *M. hesseli*. Evidence of predation by birds was seen in many collected specimens, and new categories of wing damage, Types IV (with three subcategories) and V (with two subcategories), are proposed to accommodate damage in species holding their wings folded upright at rest. It is suggested that the rudimentary, dorsal "false head" found in certain Lycaenidae may provide protection against certain kinds of predator attack. The white dot in the discal cell of the ventral forewing was found to be an unreliable field character for separating *M. hesseli* from *M. gryneus*. The character is possibly sex linked although linked to opposite sexes in these two species. It is found in 46.8% of *M. hesseli* (but never in males) and 8.1% of *M. gryneus* (but never in females). The subterminal brown bars in cells M_1 and M_2 of the ventral hindwing of *M. hesseli* were found to be reliable characters for separating this species from *M. gryneus*, in which they are absent.

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